TRANSLATION

I, Yasuyuki Sasaki, residing at 1-3-1-204, Higashimonzen, Kawasaki-ku, Kawasaki-shi, Kanagawa-ken, Japan, state:

that I know well both the Japanese and English languages;

that I translated, from Japanese into English, the specification, claims, abstract and drawings as filed in U.S. Patent Application No. 09/955,087, filed September 19, 2001; and

that the attached English translation is a true and accurate translation to the best of my knowledge and belief.

Dated: November 13, 2001

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Yasuyuki Sasaki

TITLE OF THE INVENTION

IMAGE PROCESSING APPARATUS, IMAGE FORMING APPARATUS,
AND METHOD OF THEM

BACKGROUND OF THE INVENTION

5   In recent years, a copying machine having a
developing paper photograph mode as one of script modes
makes up the majority of a full color copying machine.
Upon copying a developing paper photograph such as a
snapshot or the like by such a full color copying

10   machine, the photographs are simply laid out on a
script table to be copied, or if the photograph is a
standard size, it is enlarged to a size of an output
paper by a standard variable power to be copied.

       However, even if a user intends to copy a snapshot

15   and a photograph in an infinite form in this developing
paper photograph mode, the photographs are simply laid
out on a script table, so that the layout becomes
monotonous or unnatural spaces are produced. As a
result, the copied photographs often look sluggish.

20   Alternatively, in the case of producing a simple
photo album, this involves a problem such that
complicated work is needed such that the outputted copy
samples are cut by hand to be relocated and an
illustration and an ornament are added in order to make

25   a fine show of the photographs. Further, this involves
a problem such that an image quality is deteriorated
due to generation copy since the photographs should be

copied time and again.

In this point, for example, Japanese Patent Application KOKAI Publication No. 9-200496 discloses a technical art such that a well balanced and artistic layout is capable of being printed without troubling an operator even when image data having different aspect ratio is allocated to a frame having a predetermined aspect ratio.

However, even this technical art involves a problem such that the user must set many functions and it is not possible to automatically and easily provide an optimum layout of a plurality of photographic images.

BRIEF SUMMARY OF THE INVENTION

An object of the present invention is to provide an image processing apparatus, an image forming apparatus, an image processing method, and an image forming method which improve convenience of a developing paper photograph mode by adding an automatic size detecting function and an automatic layout function to a developing paper photograph mode of a full color copying machine.

The present invention provides an image forming apparatus comprising a scanner unit which scans a plurality of photographic images and which outputs image information upon receiving instruction of automatic edit processing; an extracting unit which extracts a position and a size of each of the plurality

of photographic images; and an image editing unit which outputs edit image, in which the plurality of photographic images are laid out within a predetermined layout, on the basis of the position and the size of each of the plurality of photographic images.

According to the image processing apparatus of the present invention, owing to scanning a plurality of photographs having different sizes, positions, sizes and the like of the photographs are automatically detected on the side of the copying machine, so that the photographs are automatically arranged in a predetermined layout to be printed out. Accordingly, a user can easily obtain an edit image for printing out a photo album appropriately arranged only by operating the copying machine so as to designate a mode and scan the plural photographs arranged on the script table, so that the user is capable of supplying this edit image to a printer unit to print out the photo album.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a sectional view for illustrating a schematic structure of a digital color copying machine to explain one embodiment of the present invention;

FIG. 2 is a block diagram for illustrating a control system of the digital color copying machine shown in FIG. 1;

FIG. 3 is a block diagram for illustrating an embodiment of an image processing unit according to the

present invention;

FIG. 4 is a flow chart for explaining a summary of processing according to the present invention;

FIG. 5 shows a plurality of examples of a photograph layout according to the processing of the present invention; and

FIG. 6 and FIG. 7 are flow charts for explaining details of the processing according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment according to the present invention will be explained with reference to the drawings below.
<Image forming apparatus according to the present invention>

At first, an example of an image forming apparatus, in which the present invention is used, will be explained with reference to the drawings.

FIG. 1 schematically illustrates an inner structure of the image forming apparatus according to the present invention such as a digital system color copying machine or the like to form a repro image of a color image. This image forming apparatus is roughly composed of a color scanner unit 1 as image reading means to read a color image on a script and a color printer unit 2 as image forming means to form a repro image of the read color image.

The color scanner unit 1 has a script table cover

3 on its upper portion. The color scanner unit 1 is
arranged opposite to an unopened script table cover 3
and has a script table 4 composed of a transparent
glass on which the script is set. Down below of the
5   script table 4, an exposure lamp 5 to illuminate the
script laid on the script table 4, a reflector 6 to
collect the light from the exposure lamp 5 on the
script and a first mirror 7 to bend the reflection
light from the script in a left direction with respect
10   to the drawing, and the like are arranged. Further,
the exposure lamp 5, the reflector 6 and the first
mirror 7 are fixed on a first carriage 8. If the first
carriage 8 is driven by a pulse motor (not illustrated),
it is moved in parallel along a lower face of the
15   script table 4.

In a left direction with respect to the first
carriage 8, namely, in a direction to which the light
reflected by the first mirror 7 is guided, a second
carriage 9 provided movably in parallel with the script
20   table 4 via an unillustrated driving mechanism (for
example, a toothed belt, a direct current motor or the
like), is arranged. In the second carriage 9, a second
mirror 11 to bend the reflection light from the script
guided by the first mirror 7 downward in the drawing
25   and a third mirror 12 to bend the reflection light from
the second mirror 11 in the right direction in the
drawing are laid perpendicular to each other. The

second carriage 9 is driven by the first carriage 8 as
well as it is moved in parallel with the first carriage
8 along the script table 4 by a half speed.

On a face including a light axis of a light folded
by the second and third mirrors 11, 12, an imaging lens
13 to image the reflection light from the third mirror
12 by a predetermined multiplying power is laid. On a
face substantially orthogonal to the light axis of the
light passed through the imaging lens 13, a CCD type
color image sensor (a photoelectric converting element)
15 is provided to convert the reflection light provided
with convergence by the image lens 13 into an electric
signal.

Thus, if the light from the exposure lamp 5 is
converged on the script of the script table 4 by the
reflector 6, the reflection light from the script is
inputted in the color image sensor 15 via the first
mirror 7, the second mirror 11, the third mirror 12 and
the image lens 13. Then, the inputted reflection light
is converted to electric signals in association with
three primary colors of a light, namely, R (red), G
(green) and B (blue) in the color image sensor 15.

The color printer unit 2 has images in which color
separation is carried out by each color component,
namely, first to fourth image forming units 10Y, 10M,
10C and 10K to form the images of four colors, i.e.,
yellow (Y), magenta (M), cyanogen (C) and black (K),

respectively, on the basis of a well known subtractive
color mixed process.

Down below respective image forming units 10Y, 10M,
10C and 10K, a feeding mechanism 20 including a feeding
belt 21 as feeding means to feed an image of each color
formed by each image forming unit in a direction
represented by an arrow A in the drawing is arranged.
The feeding belt 21 is winded and stretched between a
driving roller 91 rotated in the direction of the arrow
A by a motor (not illustrated), and a driven roller 92
estranged by a predetermined distance from the driving
roller 91, and then, the feeding belt 21 endlessly
travels in the direction of the arrow A with a
predetermined speed. Alternatively, respective image
forming units 10Y, 10M, 10C and 10K are laid in series
with the feeding direction of the feeding belt 21.

Respective image forming units 10Y, 10M, 10C and
10K include photo conductor drums 61Y, 61M, 61C and 61K
whose outer periphery is formed rotatably in the same
direction at a position contacting with the feeding
belt 21, respectively, as an image catalyst support.
The respective photo conductor drums 61Y, 61M, 61C and
61K are rotated with a predetermined speed by a motor
(not illustrated). The respective photo conductor
drums 61Y, 61M, 61C and 61K are laid so that the axial
lines thereof are at even intervals each other as well
as their axial lines are arranged so as to be

orthogonal to the direction to which the image is fed
by the feeding belt 21. Alternatively, in the
following explanation, the axial directions of the
respective photo conductor drums 61Y, 61M, 61C and 61K

5   are determined as a main scanning direction (a second
direction) and the rotational directions of the photo
conductor drums 61Y, 61M, 61C and 61K, namely, a
rotational direction of the feeding belt 21 (the arrow
A direction in the drawing) are determined as a sub

10   scanning direction (a first direction).

Around the respective photo conductor drums 61Y,
61M, 61C and 61K, charging devices 62Y, 62M, 62C and
62K as charging means elongated in the main scanning
direction, electricity removal devices 63Y, 63M, 63C

15   and 63K, developing rollers 64Y, 64M, 64C and 64K as
developing means elongated in the main scanning
direction in the same way, lower stirring rollers 67Y,
67M, 67C and 67K, upper stirring rollers 68Y, 68M, 68C
and 68K, transfer printing devices 93Y, 93M, 93C and

20   93K as transfer printing means elongated in the main
scanning direction in the same way, cleaning blades 65Y,
65M, 65C and 65K elongated in the main scanning
direction in the same way and exhaust toner collecting
screws 66Y, 66M, 66C and 66K are located in sequence

25   along the rotational directions of the photo conductor
drums 61Y, 61M, 61C and 61K, respectively.

Alternatively, the respective transfer printing

devices 93Y, 93M, 93C and 93K are laid in a position to clip the feeding belt 21 between the corresponding photo conductor drums 61Y, 61M, 61C and 61K, namely, in the inside of the feeding belt 21. Additionally,

5   exposure points of an exposure device 50 to be described later are formed on the outer peripherals of the photo conductor drums 61Y, 61M, 61C and 61K between the charging devices 62Y, 62M, 62C and 62K and the developing rollers 64Y, 64M, 64C and 64K, respectively.

10   Down below the feeding mechanism 20, paper stock cassettes 22A and 22B to contain plural sheets of paper P as an image formed medium which transcribes the images formed by respective image forming units 10Y, 10M, 10C and 10K are located.

15   Pick up rollers 23A and 23B to pick up the paper P contained in the paper stock cassettes 22A and 22B from the top thereof one by one are arranged on one end of the paper stock cassettes 22A and 22B, namely, on the side adjacent to the driven roller 92. Between the

20   pick up rollers 23A and 23B and the driven roller 92, a register roller 24 is arranged to match a front end of the paper P taken out from the paper cassettes 22A and 22B and a front end of a Y toner image formed on the photo conductor drum 61Y of the image forming unit 10Y.

25   Alternatively, the toner images formed on other photo conductor drums 61M, 61C and 61K are supplied to the respective transcription positions in conformity

with a feeding timing of the paper P fed on the feeding belt 21.

An absorption roller 26 is laid between the resist roller 24 and the first image forming unit 10Y and in the vicinity of the driven roller 92, namely, on the outer peripheral of the driven roller 92 with substantially interleaving the feeding belt 21 to provide the electrostatic adsorbability to the paper P to be fed at a predetermined timing via the resist roller 24. Alternatively, an axis line of an absorption roller 26 and an axial line of the driven roller 92 are set so as to be in parallel with each other.

A displacement sensor 96 is laid on one end of the feeding belt 21 and in the vicinity of the driving roller 91, namely, on the outer peripheral of the driving roller 91 with substantially interleaving the feeding belt 21 to detect a position of the image formed on the feeding belt 21.

The displacement sensor 96 is configured by, for example, an optical sensor of a transmission type or a reflection. A feeding belt cleaning apparatus 95 is laid on the outer periphery of the driving roller 91 and on the feeding belt 21 on the downstream of the displacement sensor 96 to remove the toner attached on the feeding belt 21 or paper grounds of the paper P.

A fixing apparatus 80 is laid in a direction such

that the paper P fed via the feeding belt 21 is removed
from the driving roller 91 to be further fed to fuse
the toner image transcribed on the paper P by heating
up the paper P to a predetermined temperature and fix

5   the toner image on the paper P. The fixing apparatus
80 is configured by a pair of heat rollers 81, oil
applying rollers 82 and 83, a web winding roller 84, a
web roller 85 and a web pressing roller 86. Then, the
toner for the use of the paper P is fixed on the paper

10 to be discharged by a pair of discharging rollers 87.

    The exposure device 50 to form the electrostatic
latent images in which color separation is carried out,
respectively, on the outer periphery of the respective
photo conductor drums 61Y, 61M, 61C and 61K has a

15 semiconductor laser oscillator 60 whose illumination is
controlled on the basis of the image data (Y, M, C, K)
for each color, in which color separation is carried
out by an image processing unit 36 to be described
later. On a light path of the semiconductor laser

20 oscillator 60, a polygon mirror 51 rotated by a polygon
motor 54 to reflect and scan the laser beam light and
F Θ lenses 52 and 53 to correct a focal point of the
laser beam light reflected via the polygon mirror 51,
and image it are provided in sequence. Between the

25 F Θ lens 53 and the respective photo conductor drums
61Y, 61M, 61C and 61K, first folding back mirrors 55Y,
55M, 55C and 55K which fold back the laser beam lights

for each color passed through the F Θ lens 53 toward
the exposure positions of respective photo conductor
drums 61Y, 61M, 61C and 61K, and second and third
folding back mirrors 56Y, 56M, 56C, 57Y, 57M and 57C

5   which further fold back the laser beam lights, which
are folded back by the first folding back mirrors 55Y,
55M and 55C are arranged.

Alternatively, the laser beam light for black is
folded back by the folding back mirror 55K, then, it is

10   guided on the photo conductor drum 61K not via other
mirror.

FIG. 2 is a block diagram for schematically
illustrating a signal flow to electrically connect and
control a digital copying machine shown in FIG. 1. In

15   FIG. 2, a control system is configured by three CPUs,
namely, a main CPU (a central processing unit) 91 in a
main control unit 30, a scanner CPU 100 of the color
scanner unit 1 and a printer CPU 11 of a color printer
unit 2. The main CPU 91 performs bidirectional

20   communication via a printer CPU 110 and a sharing RAM
(random access memory) 35. Further, the main CPU 91
issues an operation instruction and the printer CPU 110
returns to a state status. The printer CPU 110 and the
scanner CPU 100 perform serial communication, the

25   printer CPU 110 issues the operation instruction and
the scanner CPU 100 returns to the state status.

An operation panel 40 has a liquid crystal display

unit 42, various operation keys 43 and a connected
panel CPU 41 to be connected to the main CPU 91.

A main control unit 30 is configured by a main CPU
91, a ROM (read only memory) 32, a RAM 33, a NVRAM 34,
5   a sharing RAM 35, an image processing unit 36, a page
memory control unit 37, a page memory 38, a printer
controller 39 and a printer font ROM 121.

The main CPU 91 entirely manages this copying
machine. The ROM 32 stores a control program or the
10   like. The RAM 33 temporally stores the data. An NVRAM
(nonvolatile random access memory: NONVOLATILE RAM) 34
is a nonvolatile memory, which is backed up by a
battery (not illustrated). Even if an electric power
source is shut off, the NVRAM 34 holds the storage data.
15   The shoring RAM 35 is used to perform the
bidirectional communication between the main CPU 91 and
the printer CPU 110.

A page memory control unit 37 serves to store the
image information in the page memory 38 and read out
20   the image information from the page memory 38. The
page memory 38 has an area capable of storing image
information for plural pages and is capable of storing
the compressed data of the image information
transmitted from the color scanner unit 1 by one page.
25   A printer font ROM 121 stores font data
corresponding to the print data. The print controller
39 expands printer data from an outer appliance 122

such as a personal computer or the like into the image
data by using the font data stored in the printer font
ROM 121 at a resolution in association with the data
showing the resolution given to this printer data.

The color scanner unit 1 is configured by a
scanner CPU 100 to entirely manage the copying machine,
a ROM 101 to store a control program or the like, a RAM
102 for storing data, a CCD driver 103 to drive the
above described color image sensor 15, a scanning motor
driver 104 to control the rotation of the scanning
motor which moves the above described first carriage 8
or the like and an image correcting unit 105, and the
like.

The image correcting unit 105 is configured by an
A/D converting circuit to convert analog signals of R,
G and B outputted from the color image sensor 15 into
digital signals, respectively, a shading correcting
circuit to correct fluctuation of a threshold level for
an output signal from the color image sensor 15 owing
to the surrounding temperature change or the like and a
line memory to temporally store a digital signal, which
is shading-corrected, from a shading correcting circuit,
and the like.

A color printer unit 2 is configured by a CPU 110
to entirely manage the copying machine, a ROM 111 to
store the control program or the like, a RAM 112 for
storing data, a laser driver 113 to drive the above

described semiconductor laser oscillator 60, a polygon motor driver 114 to drive the polygon motor 54 of the above described exposure device 50, a feeding control unit 115 to control the deeding of the paper P by the above described feeding mechanism 20, a process control unit 116 to control the process for performing charging, development and transcription by using the above described charging device, the development roller and the transfer printing device, a fixing control unit 117 to control the above described fixing apparatus 80 and an option control unit 118 to control the options, and the like.

Alternatively, the image processing unit 36, the page memory 38, the printer controller 39, the image correcting unit 105 and the laser driver 113 are connected to each other by an image data bus 120.

<Image processing according to the present invention>

Next, the processing of a photographic image peculiar to the present invention will be described in detail by using the drawings with an emphasis of the image processing unit 36 which is a major part of the present invention cited in the above described image forming apparatus. FIG. 3 is a block diagram for illustrating an embodiment of an image processing unit according to the present invention, FIG. 4 is a flow chart for explaining a summary of the processing according to the present invention, FIG. 5 shows a

plurality of examples of a photograph layout according
to the processing of the present invention, and FIG. 6
and FIG. 7 are flow charts for explaining details of
the processing according to the present invention.

5   In the image processing of the photographic image
according to the present invention, at first, an image
whose colors are separated into R, G and B by the
scanner unit 1 shown in FIG. 2 is taken in to be
temporally stored in the page memory 38. In the next

10   place, various image processings such as filter
processing, gradation sequence processing and the like
are performed by the image processing unit 36 and the
layout information is added from the operation panel
unit 40 on the basis of information designated by the

15   user.

FIG. 3 illustrates a structure of the image
processing unit 36. The image processing unit 36 has
an input processing unit 131 in which the image is
inputted from the page memory 38 in which the scanner

20   image is stored, a position/size extracting unit 133 to
extract a position coordinate, on which the photograph
is laid out, from the output signals transmitted from
the input processing unit 131 and further, detect a
size of the photographic image, a photograph script

25   processing unit 132 to perform the image processing of
an extracted signal portion and an image editing unit
134 to add the layout and illustration information from

the operation panel 40 on the basis of the information designated by the user.

Further, the input processing portion 131 has input processing units 135, 136 and 137 of the R, F and B signals, respectively. The photograph script processing unit 132 is configured by a color converting unit 138 to convert the RGB output signals from the input processing portion 131 into cyanogen, magenta, yellow and black (hereinafter, referred to as Y, M, C, K) and a filter processing unit 139 to perform the processing such as enlargement, reduction, removal of a base, removal of a noise, emphasis of an edge and the like to the image signal output from the color converting unit 138. The filter processing unit 139 applies the filter processing to Y, M, C, and K, respectively.

Alternatively, FIG. 4 is a flow chart to explain a summary of the processing from the photograph script is inputted until the layout information is added. In this flow chart, if the instruction of the automatic edit processing of the photographic image in the developing paper photograph mode via the operation panel 40 is received from the user, by displaying in a form of a dialogue, the selection instruction with respect to the number of photographs and the layout is received form the operation panel 40 owing to the user's operation (S11).

Some sorts of the layout information are prepared
in association with the number of the photographic
images as shown in FIG. 5 as an example. FIG. 5 (a)
illustrates a layout in the case that there are two

5   sheets of the photographs, FIG. 5 (b) illustrates a
layout in the case that there are three sheets of the
photographs, FIG. 5 (c) illustrates a layout in the
case that there are four sheets of the photographs, and
FIG. 5 (d) illustrates a layout in the case that there

10   are five sheets of the photographs. Accordingly, if
the number of the photographs are designated in advance,
the user knows respective layouts as an option from a
display.

Next, in the case of providing an illustration and

15   an ornament to the image, the user instructs that the
illustration and the ornament should be provided to the
image, and further, the user selects the sorts of the
illustration and the ornament from the operation panel
40 in the same way (S12). Then, any sheets of the

20   photograph scripts are laid out on the script table and
a copy start button is pressed (S13). In the case that
the number of sheets of the photograph scripts is
different from the designated number, the user displays
a message to inform that the number sheets of the

25   photograph scripts is different from the designated
number on the operation panel 40. Then, after
resetting the script or the like, the user pushes the

copy button again.

According to such a method, since automatically acknowledge a position and a size of the photographic image, enlarge/reduce the photograph and processes the photographic image in a predetermined layout, it becomes possible to easily copy the photographs without being careful about how to lay the script and a position where the script is laid. Alternatively, it is possible that not only the photographs are laid out but also the illustration is added to space or the ornamental frame is provided to the photograph, so that a simple photo album is capable of being produced even if the user cuts the photographs by hand.

In the next place, the detailed processing of the above described image processing unit 36 will be explained with reference to flow charts shown in FIGS. 6 to 8 from point to point.

If the instruction to automatically edit the photographic image in a developing paper photograph mode is received via the operation panel 40 from the user, the instruction is displayed in a dialogue format and the instruction to select the number of the photographs and the layout is received from the operation panel 40 by the user's operation (S11). Then, if the N sheets of the photographs are laid out on the script table by the user's operation (S21), the image is scanned to be stored in a memory 38 owing that the

user pushes down a start switch (S22). This image is
binarized (S23) and the number of pixel of respective
lines in a main scanning direction and a sub scanning
direction is counted (S24). On the basis of the number

5   of pixel of respective lines, which is determined here,
the number of sheets of the photographs is detected
(S25). Then, the number of sheets of the photographs
is displayed on a control panel (S26). If the number
of sheets thereof is not N as the user instructs, a

10   message like "Relocate the scrip." or the like is
displayed, so that these processings will be repeated
until the number of sheets is recognized as an
allowable number of sheets (S28).

     In this case, if the number of sheets becomes N as

15   is instructed in advance, the operation panel 40
displays the sorts of the layout as shown in FIG. 5
(S30). If a default layout is allowable, an OK key is
pushed down and if other layout is selected, its number
or the like is selected and further, the OK key is

20   pushed down.

     Further, the user is asked whether the
illustration is displayed on the screen or not via the
operation panel 40 (S31). If the illustration is
displayed on the screen, the screen of the operation

25   panel 40 displays the sorts of the illustration to
select the number of the illustration, so that the
images selected upon the composite processing to be

described later are combined (S32).

Next, the photographic image stored in the memory 38 is read out (S33). Then, on the basis of the number of pixel obtained in the step S24, a coordinate position of the photograph is calculated by the position/size extracting unit 133 (S34). Further, if the inclined photographic image is detected and it is found that this image exists, the image editing unit 134 corrects the inclination by using, for example, an affine conversion or the like (S35).

Then, in the image editing unit 134, referring to a positional coordinate and a size of respective photographic images detected in advance, respective photographic images are enlarged or reduced if necessary so that these photographic images are set in the layout selected by the user in the step S30 (S36). Therefore, the edit image according to the selected layout can be obtained. Then, the edit image is transferred to the color printer unit 2, a plurality of photographic images are formed on the image forming medium by the color images.

As described above, the present invention relates to processing in a developing paper photographic mode of a digital full color copying machine and the present invention provides an image forming apparatus to provide a plurality of photographic images, in which a good layout having a good picture quality and a good

appearance.

In other words, according to a conventional developing paper photograph mode, upon copying the developing paper photograph such as a snapshot or the like, the photograph is simply laid out on the script table to be copied, or if the photograph is a standard size, it is enlarged to a size of an output paper by a standard variable power to be copied. The image forming apparatus according to the present invention is capable of solving a layout problem occurred in the case of copying a snapshot and a photograph in an infinite form according to this method such that the layout of the photographs is monotonous or unnatural spaces are produced, so that the copied photographs look sluggish, a problem of complicated works such that, in the case of producing a photo album by using the copied photograph, it is needed that the outputted copy samples are cut by hand to be relocated and an illustration and an ornament are added in order to make a fine show of the photographs, and further, a problem such that an image quality is deteriorated due to plural times of copying accompanied by these works or the like.

In other words, according to the image processing apparatus, the image forming apparatus, the image processing method, and the image forming method, a size and a position of the photographs laid out on the

script table are automatically detected in an automatic
edit mode and the user automatically corrects the
layout in accordance with the layout information
selected from some sorts of patterns by the user, so

5   that the user is not burdened with the location of the
photographs and how to lay the photographs. Further,
according to the image processing apparatus, the
illustration information and the ornamental frame are
capable of being added, so that it is possible that a

10   simple photo album or the like is easily produced
without deterioration of a picture quality due to
plural times of copying.